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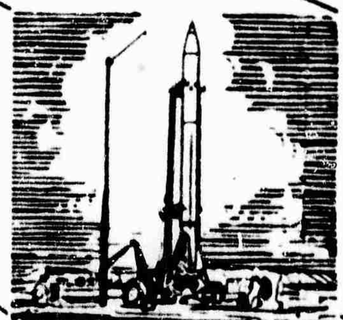
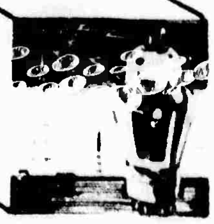
RESEARCH AND DEVELOPMENT ON MINE FUZES AND RELATED ITEMS (U)





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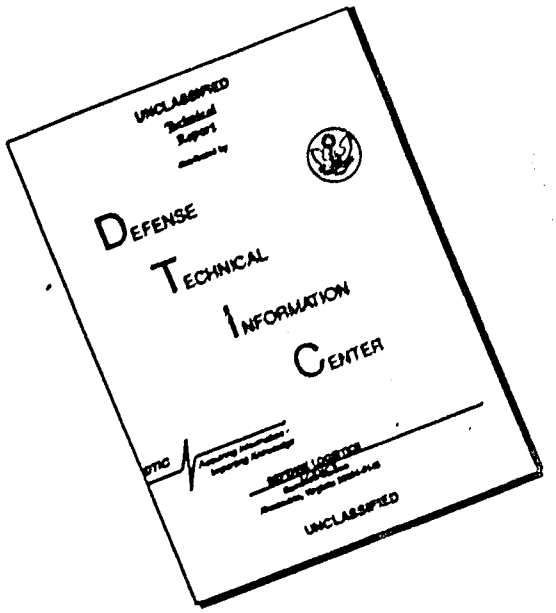

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DIAMOND ORDNANCE FUZE LABORATORIES

John A. Ulrich, Lt Col
COMMANDING

W. S. Hinman, Jr.
TECHNICAL DIRECTOR

The Diamond Ordnance Fuze Laboratories is a Class II Ordnance installation under the Command of the Chief of Ordnance.

The mission of the Laboratories is as follows:

1. Conduct research and development in the various physical science and engineering fields directed toward meeting the military characteristics for fuzes and related items.

2. Provide consulting and liaison services as required in connection with the development, production and use of items developed in the Laboratories or of related items.

3. Fabricate models and prototypes of items under development at the laboratories.

4. Perform developmental testing, including destructive testing of prototypes.

5. Collect, evaluate, produce, and maintain ordnance logistical intelligence required of the Ordnance Corps under the Army Intelligence Program.

The Diamond Ordnance Fuze Laboratories was established by the Ordnance Corps, Department of the Army, on 27 September 1953. The nucleus for these Laboratories was the personnel and facilities of the Ordnance Divisions of the National Bureau of Standards. The Diamond Ordnance Fuze Laboratories is now responsible for the fuze programs formerly conducted at that Bureau.

Typical fields of activity at the Diamond Ordnance Fuze Laboratories includes electronics, physics, mechanics, chemistry, and applied mathematics. Examples of topics in these activities are radiation and field studies, circuit theory and design, development and engineering of mechanical and electromechanical devices, chemical problems, and special electron tube design. The programs include all phases from basic research to product design.

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DIAMOND ORDNANCE FUZE LABORATORIES

DOFL PROJECT
Laboratory 500
Branch 530

DOFL REPORT
PR-58-21

WASHINGTON 25, D.C.

26 August 1958

Quarterly Progress Reports

RESEARCH AND DEVELOPMENT

ON

MINE FUZES AND RELATED ITEMS (U)

1 July -- 30 Sept 1958

ORDNANCE CORPS • • • DEPARTMENT OF THE ARMY

SECRET

FOR THE COMMANDER:

W. S. HINMAN, Jr.
Technical Director
Diamond Ordnance Fuze Laboratories

C O N T E N T S

DIAMOND ORDNANCE FUZE LABORATORIES

PROJECT NO. TS1-200 **D A** - 5S07-06-011 **ENGINEER(S)** CFWatkins/7331 JRichardson/7371

PROGRESS REPORT FOR PERIOD 1 July - 30 Sept 1958

TITLE Control, Remote, Land Mine Fuze, T39 (U)

PRIORITY D/A 1-A **OCO** 20 **SECURITY CLASS:** (Basic Project) Secret

DATE ITEM STARTED 1952

Phase schedule

Qtr.	FY 58	FY 59				FY 60	FY 61	FY 62	FY 63
	4	1	2	3	4				
Phase		ED	ED	ED	ED	ED ET DP(1)	RI(3)	UT	UT TC RP

OBJECTIVE

This item is part of a broad program (ref OTCM 34282, dated 6 May 1952) for the development of a family of antivehicular land mine fuzes. It is desired to control the state of arm of fuzes remotely without the use of connecting wire circuits in order to accommodate the passage of friendly tanks through a mine field. In the item under development, a low audio-frequency electromagnetic signal is transmitted through the ground from friendly territory; and a receiver located with the mine controls the state of arm of the influence fuze after reception of, and time interval between, the proper signals.

STATUS (Reporting date, 22 August 1958)

1. Phase. - Engineering Design.
2. Results Since Last Reporting Date

a. The transmitter input signal circuit was modified to meet the increase in pulse width and amplitude requirements set by the General Electric Company. The unit was shipped to GE for testing with the inverters but the pulse forming circuit was assymmetrical and the inverters did not function

(Continued on following page)

PLANNED OBJECTIVES FOR NEXT PERIOD

a. Continue testing and modification of input circuit.
b. Begin preparation of equipment for field test.
c. Further development of receivers awaits laboratory and field testing of the recently acquired transmitters.
d. Continue preparation of Interim Summary Technical Report.

RECOMMENDATIONS - Continue as planned

BIBLIOGRAPHY - None DOFL Project No. 52058

TSI-200 (T39) (U) - Continued

2. Results Since Last Reporting Date (continued)

properly. A temporary input signal circuit suitable for testing purposes was built so that acceptance tests could be made on the inverters at GE. The inverters performed satisfactorily with the temporary circuit and were accepted.

b. The two transmitters have been received at DOFL. One of the units has been set up in the laboratory for further testing and modification.

* * * *

DIAMOND ORDNANCE FUZE LABORATORIES

PROJECT NO. TS1-200 D A 5S07-06-011

ENGINEER(S)
A. E. Peterson/7108
N. C. Butler/7108

PROGRESS REPORT FOR PERIOD 1 July - 30 Sept 1958

TITLE Initiation System for Mine, APERS, T48E1 (U) - Including: Firing Device, Elec., T49; Tester, Circuit, T10; and Initiating Element , T _

PRIORITY D/A 1-A OCO 20 SECURITY CLASS: (Basic Project)Confidential

DATE ITEM STARTED
22 March 1956

Phase Schedule

Qtr.	FY 58 4	FY 59 1	2	3	4	FY 60	FY 61	FY 62	FY 63
Phase		ED	ET DP	ET	UT	TC			

OBJECTIVE

To develop an initiation system for the T48E1 Antipersonnel Mine.

STATUS (Reporting date, 19 August 1958)

1. Phase.- Engineering Design.

2. Results Since Last Reporting Date

T49 Firing Device, Electric. Following tests made on hand-made prototypes, mold fabrication was begun by the DOFL shops and is 50% completed. A sealing boot design was evolved and tested; compounds were prepared in the NBS Rubber Section and molded at DOFL. Generator units and their trigger mechanisms for ET prototypes are ready for assembly. Drawings are as nearly complete as practicable at this stage.

T10 Circuit Tester. A contract was let for making 5 units, with design modifications based on a study of earlier samples. (Tests will determine if these can serve as prototypes for ET quantities).

(Continued on following page)

PLANNED OBJECTIVES FOR NEXT PERIOD

Complete ET quantities in this period and make final tests on these items prior to submission for the ET program.

RECOMMENDATIONS

Continue as planned.

BIBLIOGRAPHY

DOFL Project No. 52151

None

TS1-200 (T48E1) - Continued

Initiating Element T . Blasting caps, cables and connectors for preliminary and engineering tests have been ordered; delivery is expected in September. A method of attaching the cap leads to the cables, using crimped connectors, has been worked out.

Carrying Kit. A sample was made up and submitted to PA for comment.

* * *

DIAMOND ORDNANCE FUZE LABORATORIES

PROJECT NO. TS1-200 **D A** -5A07-06-011 **ENGINEER(S)** DWFinger/7108 NCButler/7108

PROGRESS REPORT FOR PERIOD 1 July - 30 Sept 1958

TITLE Fuze, Mine, AT, T1217E2 (U)

PRIORITY D/A 1-A **OCO** 20 **SECURITY CLASS: (Basic Project)** SECRET

DATE ITEM STARTED
1953

Phase Schedule

Qtr.	FY 58	FY 59				FY 60	FY 61	FY 62	FY 63
	4	1	2	3	4				
Phase		ED	ED	ED ET DP	ET	UT RI (1)	UT TC		

OBJECTIVE

This project is part of a broad program (ref OTCM 34282, dated 6 May 1952) for the development of a family of antivehicular land mine fuzes. The fuze is pressure operated and will explode an AT mine under the area of a tank. It uses two extended pneumatic tubes; compression of these, one by each tank tread, results in functioning of the electric detonator. Other uses for the fuze, such as in booby-trapping, are readily visualized.

STATUS: (Reporting date 19 August 1958)

1. Phase: Engineering Design (NOTE: Phase schedule changed since previous report).

2. Results Since Last Reporting Date

a. The remaining fuzes of this lot have been received, completing delivery of the 200 fuzes. Tests of the function switches indicate that some switch contacts are contaminated by foreign matter, probably epidermal oils. Measurements have also disclosed a disturbing decay of battery open circuit voltage. About 10% of the 150 fuzes checked exhibit voltages less than half the nominal 180 volts. While the lower limit for operation is about 75 volts, further decay seems probable in those samples.

(Continued on next page)

PLANNED OBJECTIVES FOR NEXT PERIOD

Engineering Development will be continued and Engineering Test should be completed.

RECOMMENDATIONS

Continue as planned.

BIBLIOGRAPHY

None

DOFL Project No. 52150

TS1-200 (T1217E2) - Continued

2. Results Since Last Reporting Date - Continued

b. Watchmakers assembling the Elgin-made parts to produce timers for this fuze have encountered difficulties in producing acceptable timers, judged by our arbitrary requirement to run through the complete arming cycle ten consecutive times without any failure. Wear on the timer during this testing is negligible. The difficulties arise primarily from an uneven torque delivered to the pin lever escapement, which can run only when driven by a finite range of torques. Additional work on the #1151 timer for this fuze has pinpointed the major cause of torque loss with consequent clock stoppage. The screwdriver type coupling between movement drive pinion and movement drive stud was replaced with a rigid one-piece pinion in eight timers typical of those which previously operated erratically. With the new pinion, these eight operated satisfactorily.

c. Ten fuzes were tested at APG for resistance to sympathetic detonation and function against a tank. All fuzes were assembled to inert-loaded T29 mines, with externally connected heat squibs to indicate fuze function.

Six rounds were buried with the top of the fuze 2 in. below the surface, with tubes buried at a nominal 1 in. depth. The remaining four were placed on the surface, with tubes also on the surface. Twelve pounds of composition C^3, molded in an ice cream carton, was buried 4 in. below the surface and fired to simulate a mine detonation. All the heat squibs were inspected to confirm non-function, then an M47 tank passed over the buried fuzes while those heat squibs were observed for function. The surface emplaced rounds were stimulated for function by flattening about 1-in. of the tubes by hand.

Using four charges, there were 40 opportunities for malfunction and 40 subsequent opportunities for function. Those fuzes placed above ground resisted sympathetic detonation and functioned properly 16 times out of 16 opportunities, at distances ranging from 8 to 32 feet from the charge. Those emplaced normally resisted sympathetic detonation 24 times and functioned properly 23 times at distances ranging from 6 to 48 feet. The non-function occurred after the last charge was fired. This fuze was later examined in the laboratory and found functionable, therefore the cause of failure remains unknown.

d. Two fuzes were tested for function against light wheeled vehicles inside the DOFL compound area. Using a 3160 pound carryall in hard dry soil, there were 13 functions out of 24 opportunities. Thirty-nine overpassages were made with a 3349 pound pickup truck, with twenty-four functions.

e. Ten fuzes are currently undergoing summer environmental field tests at Yuma Test Station

* * * *

DIAMOND ORDNANCE FUZE LABORATORIES

PROJECT NO. TS1-200 UA-5507-06-011 **ENGINEER(S)** P. H. Winter/7621, P. G. Gerhard/7344

PROGRESS REPORT FOR PERIOD 1 July - 30 Sept 1958

TITLE Fuze, Mine, AT, T1224E2 (U)

PRIORITY D/A 1-A **OCO** 20 **SECURITY CLASS: (Basic Project)** Secret

DATE ITEM STARTED 1955

Phase Schedule

Qtr.	FY 58 4	FY 59 1	2	3	4	FY 60	FY 61	FY 62	FY 63
Phase		ED	ED	ED DP	ED ET	ET RI(3)	UT	TC RP	

OBJECTIVE

This fuze is part of a broad program (ref OTCM 34282, dated 6 May 1952) for the development of a family of antivehicular land mine fuzes. It utilizes a combination of vibrational and magnetic influences to function the mine when the target is in a vulnerable position. The fuze is the same as the T1224E1 except that it incorporates (a) improved sensing elements which can better recognize desired targets and reject unwanted targets or countermeasures, and (b) selectable self-sterilization. (The self-sterilizing mechanism developed for this fuze will also be used in T1217E3, T1233, T1235, and possibly other fuzes.)

STATUS (Reporting date, 19 Aug 1958)

1. Phase.--Engineering Design.
2. Results Since Last Reporting Date

(a) All 25 fuzes (without sterilizer) have been received from Lionel Corporation and are in the process of laboratory testing.

(Continued on following page)

PLANNED OBJECTIVES FOR NEXT PERIOD

a. Continue laboratory and field tests and evaluation.
b. Conduct further studies of multimorph slave braking system.
c. Prepare report on field tests of trembler switches.
d. Continue development of the DOFL timer unit.
e. Continue consultations with General Time Corporation in connection with procurement of followup units.

RECOMMENDATIONS -- Continue as planned.

BIBLIOGRAPHY -- None.

DOFL Project No. 52059

TS1-200 (T122$\frac{1}{4}$E2)--Continued

2. Results Since Last Reporting Date--Continued

(b) Preliminary data indicate fairly close agreement between design and performance characteristics. Some further adjustment probably will be necessary.

(c) Trembler switches have been made for the 25 fuzes. These new type 3-terminal transfer switches will replace the old type 4-reed switches used in the T122$\frac{1}{4}$E1 fuze. As planned, these switches will be sensitive to horizontal motion rather than vertical motion as in previous models.

(d) Bids were received from four contractors for the production of 20 sterilizer followup units of the cutaway gear type. After evaluation of the bids, a contract was awarded to Westclox, a division of General Time Corporation.

(e) A second model of the timer unit incorporating the new balance wheel contacting system was constructed at DOFL and is operating very satisfactorily. This model does not include the pulse generating components.

(f) Modifications were made on the three Hamilton timers, and two of the three have been running for more than a month.

(g) Satisfactory methods were demonstrated for obtaining firing capacitor voltage from the protective circuit on the clock contacts for fail-safe sterilizer operation. These circuits are adaptable to both high voltage (carbon bridge) and low voltage (wire bridge) detonators.

* * *

DIAMOND ORDNANCE FUZE LABORATORIES

PROJECT NO. TS1-200 DA-5S07-06-011 **ENGINEER(S)** J. M. Shaull/7344, K. D. Zastrow/7343

PROGRESS REPORT FOR PERIOD 1 July - 30 Sept 1958

TITLE Fuze, Mine, AT, T1233 (U)

PRIORITY D/A 1-A **OCO** 20 **SECURITY CLASS:** (Basic Project) Secret

DATE ITEM STARTED 1952

Phase Schedule

Qtr.	FY 58 4	FY 59 1	2	3	4	FY 60	FY 61	FY 62	FY 63
Phase		ED	ED	ED	ED	ED ET DP(2)	RI(1)	UT	RP

OBJECTIVE

This fuze is part of a broad program (ref OTCM 34282, dated 6 May 1952) for the development of a family of antivehicular land mine fuzes. It is an influence fuze employing electronic sensing elements to detect changes in the permeability and conductivity of the space above the ground, and capable of analyzing these changes in order to recognize desired targets and reject spurious signals. It is not intended to employ moving parts to accomplish this detecting function.

STATUS (Reporting date, 19 Aug 1958)

1. Phase.--Engineering Design.

2. Results Since Last Reporting Date

a. Two T1233 prototype fuzes were tested in three events each in the Hardtack Atomic Test Series. Several types of trigger circuits were tested separately and also a number of passive transistors and semiconductor diodes of appropriate types for fuze use. Results are reported under Project TS1-210.

(Continued on following page)

PLANNED OBJECTIVES FOR NEXT PERIOD

a. Construct and test six new prototype fuzes with manual zeroing.
b. Try use of voltage sensitive aluminum oxide switch in place of transistor blocking oscillator for firing detonator.
c. Continue study of self-zeroing system.
d. Continue work on interim technical report.

RECOMMENDATIONS - Continue as planned.

BIBLIOGRAPHY - None.

DOFL Project No. 52054

TS1-200 (T1233)--Continued

2. Results Since Last Reporting Date--Continued

b. A modified T1233 fuze prototype was constructed and tested. This unit uses a 3-terminal DOFL trembler switch to excite the ringing oscillator in a balanced phase manner to provide equal sensitivity for signatures of either polarity. The transistor used to charge the firing capacitor is now connected in an "inverted" manner to give better switch action in the cutoff or unexcited condition.

c. Continued study of the magnetic sensing element indicates that molybdenum permalloy strips one or two mils thick give greatest uniformity between units, and lowest null output.

d. An impulse-motor self-zeroing system was constructed and successfully demonstrated. Miniaturization and switching problems are still formidable.

* * *

DIAMOND ORDNANCE FUZE LABORATORIES

PROJECT NO. T S1-200 D A - 5A07-06-011 ENGINEER(S) REMcCoskey/7621

PROGRESS REPORT FOR PERIOD 1 July - 30 Sept 1958

TITLE Fuze, Mine, AT, T1235 (U)

PRIORITY D/A 1-A OCO 20 SECURITY CLASS: (Basic Project) Secret

DATE ITEM STARTED

1955

Phase Schedule

Qtr.	FY 58	FY 59				FY 60	FY 61	FY 62	FY 63
	4	1	2	3	4				
Phase		ED	ED	ED	ED DP ET	ET RI(3)	UT	TC KP	

OBJECTIVE

This fuze is part of a broad program (ref OTCM 34282, dated 6 May 1952) for the development of a family of antivehicular land mine fuzes. It identifies the target by detecting changes in the gamma radiation intensity backscattered from a vehicle to a fuze after emission from a moderate intensity radioactive source nearby. Detection is accomplished with a scintillation crystal and photomultiplier tube with associated circuitry. A second influence, ground vibration, must also be present for fuze function.

STATUS (Reporting date, 18 August 1958)

1. Phase. Engineering Design.
2. Results Since Last Reporting Date.

a. A contract was awarded to Tracerlab, Inc., for the construction of 100 fuzes with the following delivery schedule:

(1) 15 fuzes by 30 Nov 1958
(2) 50 fuzes by 28 Feb 1959
(3) 35 fuzes by 30 June 1959

(Continued on following page)

PLANNED OBJECTIVES FOR NEXT PERIOD

1. Work on the Interim Summary Technical Report will continue.
2. Field tests of model two fuzes will be performed to check out fuzes containing trembler switches and transistor oscillator power supplies.
3. Work on the new scintillation detection scheme will be continued.

RECOMMENDATIONS - Continue as planned

BIBLIOGRAPHY - None

DOFL Project No. 52055

TS1-200 (T1235) - Continued

2. Results Since Last Reporting Date - Continued

These fuzes may not contain solid electrolyte batteries, since at this time, there are no batteries of this type available that will meet applicable military standards. Parallel efforts are being carried out at DOFL and Tracerlab on a transistor oscillator high voltage power supply (energized by mercury cells) for this fuze.

b. Work continues on the new approach to detection of low level gamma radiation as applied to this fuze. While the method is theoretically possible, experimental difficulties have been encountered in the high frequency, high impedance electrical circuit. Negotiations with RCA have been started for the construction of two special vacuum phototubes for this project.

c. Work continues on the preparation of the Interim Summary Technical Report, which is about two-thirds finished.

d. Results of the tests on the two T1235 fuzes exposed in Operation Hardtack are a part of Project TS1-210 and are reported therein.

* * * *

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